

Relocation risky for bumblebee colonies

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Climate change may threaten bumble bees, but experimental relocation is a ~~verifiably~~-risky solution

Kerr *et al.* (1) provide an impressive analysis of a massive *Bombus* natural history collection data set that suggests an alarming pattern of shrinking bumble bee ranges correlated with climate change on a continental scale. The study supports previous work (2) that climate change is likely to affect bumble bee distributions, and provides yet another example of the impacts that anthropogenic alterations to the environment are having on organisms across the planet. We take issue, however, with one statement in the last paragraph: "Experimental relocation of bumblebee colonies into new areas could mitigate these range losses" (1). Although this is but a single sentence, such a simple-sounding solution can often carry considerable weight, and the underlying complexities and challenges should be clearly referenced when suggesting risky strategies in publications. This is especially true in the case of bumble bees, where ~~experimental~~-relocations have already been undertaken, with arguably disastrous outcomes. Specifically, intercontinental movement of species for pollination services have been implicated in threats to native bumble bee fauna worldwide (3). One example of such unintended experiments into the effects of *Bombus* relocation is the introduction of European species (*B. terrestris*; *B. ruderatus*) into South America, which has contributed to the catastrophic collapse of native bumblebee species (4, 5).

Perhaps the greatest risk of interregional transportation lies with the spread of disease, ~~gone of the~~ factors not considered by Kerr *et al.* (1), but suspected to be ~~behinda factor in~~ the decline of some species included in this study (6). Bumble bees may host a diverse array of parasites, and transported colonies may negatively impact native pollinator communities through co-introduction and spread of disease (5). Competition with native fauna is also a concern (3), as are various evolutionary and population genetic factors (e.g., incomplete knowledge of taxonomy, phylogeography, intraspecific variation that contributes to local climatic adaptation or range limitations and effects of interspecific hybridization) (7). If species could be relocated to bumble bee free habitats, transplant experiments could prove to be a useful strategy, however it is difficult to imagine many scenarios in Europe or North America where relocated colonies would not encounter native bee fauna. Ultimately, efforts to overcome perceived challenges to a species' natural ability to match climatic shifts must be preceded by detailed ecological and evolutionary studies in both source and destination regions, otherwise the precautionary principle should be applied prior to further human-mediated movement of bumble bees within or beyond current species boundaries.

At a time when researchers are arguing for greater regulation of interregional bumble bee movement, e.g., (5, 8), the suggestion of colony relocation as a possible conservation strategy (1) is concerning. The conclusion that bumble bees are threatened by climate change (1) is neither disputed nor surprising, however, we note that other factors are known to threaten pollinators, including parasites (5), specific land use changes (9), pesticides (10), and ~~genetic impoverishments~~ (7). The failure to include pathogens in the analysis, in particular, makes the climate data hard to evaluate meaningfully in isolation and could have the unanticipated side-effect of encouraging the commercial *Bombus* rearing industry to argue for unrestricted movement of domesticated species. We also agree that mechanistic knowledge of responses to

Commented [DG1]: Is this the best reference? I think the recent Rasmont paper might be better here? BioRisk 10: 1-236 (18 Feb 2015) doi: 10.3897/biorisk.10.4749

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Commented [DG3]: It is hard to summarize this in a few words, but of course it is not "genetics" that threatens bumblebees, but loss of genetic diversity. I'm not sure that my suggested change is an improvement though!

climate change is needed to test these new predictions, and that to best understand the potential for future adaptation to climatic shifts, studies should ideally encompass the full extent of species' spatial and climatic distributions. Our concern is that by potentially overstating the case for climate change, the analysis of Kerr *et al.* (1) could be counterproductive for pollinator conservation efforts by providing an incomplete picture of the complex factors driving bumble bee decline, and suggesting environmentally risky management recommendations. Bumble bees have had a long evolutionary history and ~~have demonstrated~~ a remarkable ability to adapt to challenging environments as they've colonized the world. In the absence of comprehensive mechanistic knowledge, it may be preferable to allow evolution to do its work, rather than ~~riskingmaking~~ further anthropogenic ~~interventionsferencemodifications~~ that could have short-term benefits to ecosystem services but long-term consequences ~~forte~~ global pollinator communities.

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